

The equation of state of an ideal gas

- **Ideal gas**: The gas molecules can be treated as pool balls.
- Examples: O₂, N₂, He, etc. (no interaction between them)
- An **equation of state** is an equation for the macroscopic variables of a thermodynamic system.
- For an ideal gas, the **macroscopic variables** are:
 - number of molecules/moles $N, n=N/N_A$
 - pressure P
 - temperature T
 - volume V

The ideal gas law

- general form: $PV = NkT$

Boltzmann constant: k or $k_B = 1.38 \cdot 10^{-23} \text{ J/K}$

- equivalent form: $PV = nRT$

universal gas constant: $R = 8.314 \text{ J/(mol K)}$

- constant mass: $PV \propto T$

- constant mass, temperature (Boyle-Mariotte):

$$PV = \text{constant}$$

- constant mass, pressure: $V \propto T$

- constant mass, volume: $P \propto T$